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produced 166,562 tons of alkali, less than was imported, while in 1900 the production was 539,541 tons and in 1905, 734,209 tons. In the last two periods the importation of bleaching-powder into the United States had decreased from 136,403 tons to 96,110 tons. Unfortunately this statistical portion is the only part of the book not brought well down to date.

J. L. H.

The Elements of Statistical Method. By WILLFORD I. KING, M.A. New York, The Macmillan Company. 1912. Pp. xvi + 250.

It is "the purpose of this book to furnish a simple text in statistical method for the benefit of those students, economists, administrative officials, writers, or other members of the educated public who desire a general knowledge of the more elementary processes involved in the scientific study, analysis and use of large masses of numerical data."

With this purpose in mind, the author presents only the most simple of the mathematical theorems on which the statistical method is based. The book is arranged so as to treat the subject in four main parts: (1) The historical development and general characteristics of statistics; (2) the gathering of material; (3) analysis of material collected; (4) comparison of variables. The great variety of topics dealt with under these general headings indicates the breadth of view desirable for an adequate treatment of statistical problems, and suggests the many pitfalls that endanger the certainty of conclusions drawn from some kinds of statistical data. The book is to be commended for the clearness with which it brings a large number of topics concerning statistics to the attention of the educated public. This is surely a matter of the highest importance.

It seems desirable to criticize the treatment of the notion of "the probable error." On p. 78, we find the following statement: "If E = the possible error of the arithmetical average, the probable error of the same is approximately E/\sqrt{n} ." For proof, we are referred to Bow-

ley, "Elements of Statistics," pp. 303-315. I fail to find that Bowley attempts to obtain a relation between probable and possible errors. He does show, within the limits of this reference, that the probable error of the arithmetic mean of n variates is E/\sqrt{n} , where E is the probable error of a single variate. It seems to the reviewer that the book is not clear on the notion of a probable error, and even presents an incorrect conception of this subject. On pp. 213-214, the statement is made that the probable error of a coefficient of correlation varies inversely both with the number of pairs of items and with the size of the coefficient. Then the well known formula

$$\frac{0.67(1-r^2)}{\sqrt{u}}$$

is given for this probable error. It is therefore obvious that the author does not use the expression "varies inversely" in its usual meaning in mathematical sciences. Later, on p. 214, is the statement that the probable error indicates that the chances are that r actually lies between

$$r + \frac{0.67(1-r^2)}{\sqrt{n}} \quad \text{and} \quad r - \frac{0.67(1-r^2)}{\sqrt{n}}.$$

This statement is obvious but useless when taken in one sense. It tends to give an incorrect conception of the meaning of a probable error, when taken in another and important sense.

To summarize, it seems to the reviewer that the strength and usefulness of the book lies in its popular presentation of some of the leading ideas of the best statistical method of the present day. The weakness of the book lies in its presentation of a vague and even incorrect conception of the meaning of the probable error of a statistical result.

H. L. RIETZ

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POPULAR AND TECHNICAL BOOKS ON HEREDITY
Einführung in die Vererbungswissenschaft.
By RICHARD GOLDSCHMIDT. Leipzig, Wilhelm Engelmann. 1911. Pp. x + 502.
Price, 12.25 M., paper, 11 M.

This book is one of several from German authors that have been welcomed by American students because of the want of a suitable text in our own language. In twenty chapters the author treats of variation and statistical methods, with their present and former application, mutations and fluctuations, inheritance of acquired characters, Mendelism, mechanism of heredity, graft hybrids, and sex-determination.

Statistical methods are discussed briefly, not as in a text-book of statistics and their manipulation, but merely to point out the kind of problem amenable to attack in this way. The author is, however, cautious in advocating statistical methods, pointing out as others, particularly Johannsen, have done, that mathematics without biological analysis is valueless. At the close of the discussion of biometrics, Galton's laws of regression and of ancestral contributions are briefly reviewed, but the view is advocated that these laws are no longer of biological value. In the conclusions drawn from the study of pure lines, the author is in substantial accord with Johannsen.

Mutations are regarded as probably not essentially different from fluctuations, the latter being capable, under certain circumstances, of becoming the former. This conclusion is based largely on the work of Tower. The question of mutations then becomes, What fluctuations may become heritable, and under what circumstances?

Prefatory to a discussion of acquired characters, much evidence is adduced to show a connection between somatic and germ cells. In this evidence is included the effects of gonad extracts upon somatic characters, though one may wonder what bearing this has upon somatic influence on germ cells. One misses the negative results obtained by Smith from injections in fowls, but the book was probably written too early to include this. Guthrie's transplantation experiments are accepted at par, though there seems good reason to doubt their validity.

The inheritance of acquired characters is

believed, on the strength of the newer evidence, to be probable. Goldschmidt is the more ready to adopt this view because he regards mutations as only special forms of fluctuation. The theory of parallel induction (the simultaneous action of the environment on both soma and germ cells so as to produce identical variations in parent and offspring), which was supported by Tower's experiments on *Leptinotarsa*, meets, in the author's opinion, an insurmountable difficulty; but how simple induction (the effect of an already modified soma on the germ cells so as to produce the same modification in the offspring) encounters any less insurmountable difficulties, is not explained. They seem to the reviewer to be equally inconceivable.

The half dozen chapters on Mendelism constitute a treatise, for the most part elementary, in which are discussed the various cases of mono-, di- and poly-hybrids. Doubt is expressed as to whether species hybrids exhibit Mendelian behavior, on the ground that equality of reciprocal crosses is a rule of Mendelism, whereas in many species crosses the reciprocal crosses are distinctly unequal. The reviewer finds cases where reciprocal varietal crosses are also unequal. To explain intermediate F_1 the author accepts as probable the assumption that many genes combine to produce a single visible character.

The Sutton-Boveri hypothesis of the segregation of genes is rejected on the ground that there are cases in which there are more independently heritable characters than there are chromosomes, notwithstanding the fact that the existence of such cases has not been demonstrated to the satisfaction of all geneticists. In its place the author adopts a theory of end-to-end union of the chromosomes (telosynapsis) in such a way that either maturation division may be a reduction division, whereby the number of possible combinations is greatly increased. The individuality of the chromosomes is not maintained in this theory.

The chapters on sex-determination are perhaps one of the least satisfying parts of the book. This is partly owing to the unsettled

condition of the subject. One could wish, however, for a fuller analysis of the more important current theories. According to the author, secondary sexual characters afford no evidence fitted to solve the problems of sex. The evidence of Mendelian inheritance of sex is strongest in sex-limited inheritance; but even here a non-Mendelian hypothesis is held to be better. Sex-determination is a phenomenon of cell physiology and cell regulation. "To say more would certainly be premature."

Several minor criticisms might be made. Typographical errors are infrequent. "Biotype" is made synonymous with "pure line" on page 122. One feels that the inheritance of acquired characters could be discussed more judiciously after Mendelism, instead of before it. On the whole, however, the book is very well written and well made, and will be a valuable aid to both teachers and students.

The Heredity of Richard Roe. By DAVID STARR JORDAN. Boston, American Unitarian Association. 1911. Pp. 165. Price, \$1.20.

Heredity in the Light of Recent Research. By L. DONCASTER. Cambridge, The University Press. 1911. Pp. 143. Price, 40 cents.

These two books are intended for the laity, and are excellently designed for their purpose. Richard Roe is a typical man, whose history is described from germ cell to manhood. The author's treatment of his hero is conditioned by his public, and is popular to a degree not usually combined with accuracy. Because the book will be read by the uninitiated, one feels that the case against prenatal influences, for example, could have been made stronger without compromising the author's scientific standing. There is considerable matter in the latter part of the volume that seems at first sight irrelevant to the heredity of Richard Roe. But the whole book is written in such delightful style, a style which those acquainted with the author will at once recognize, that differences of opinion regard-

ing emphasis or relevance are quickly forgotten.

If Jordan's book furnishes inspiration, Doncaster's supplies information. The latter volume gives, in small compass, the main facts of heredity in a form readily grasped by any intelligent reader, yet with all the accuracy which the author's scientific reputation leads one to expect. Heredity is approached by the usual road, with a discussion of variation, its causes, and its study by statistical methods. The reader is given an elementary understanding of Mendelism, and is led within sight of some of the disputed questions regarding purity of gametes, inheritance of acquired characters, etc. Heredity in man, with its sociological bearing, closes the main part of the volume. Two appendices treat of the history of theories of heredity and the material basis of heredity. There is a short glossary, and a bibliography in which those books suitable for general readers are specially designated.

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A CLASSIFICATION OF THE DEPARTMENTS OF BOTANY AND AN ARRANGEMENT OF MATERIAL BASED THEREON

No one has made a serious attempt at the classification of the departments of botany. Various short classifications have been given in text-books with a view to arranging the facts presented to botanic students, but I am not aware that these have been made with a thought at presenting in logical sequence the divisions into which botany naturally may be divided. Such an arrangement is an important matter when the botanist wishes to arrange his books, photographs, microscopic and lantern slides, as well as museum material of plants. Recognizing the lack of such information, the attempt is made here to give a logical classification of the departments of botany, and it is hoped that the readers of SCIENCE will make additions and corrections, or suggest a rearrangement of this preliminary